Research on the Collaboration between Industries and Secondary Technological and Vocational Schools — a Case Study of Siemens Mechatronic Systems Certification Program (SMSCP)

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Abstract

The industry-school collaboration has been encouraging by Taiwan MOE for solving the manpower supply gap. Under that policy, SMSCP has been launched by NKHS and Siemens. This paper aims to explore how the collaboration works and to analyze the models in Taiwan, Germany and Korea based on Siemens's experience, and make recommendations for improvements. According to the findings, the collaboration can be started from teachers ' training, students' field internship and technical certification. And talent cultivation always needs dynamic adjustment, schools should be granted more flexibility to change school practices to grasp social pulse. Giving the enterprise subjectivity in the VET and providing schools the estimating of future labor market are needed to strengthen the cooperation. Schools with automation and mechatronic relative departments should link with the enterprise to give holistic and hands-on education to supply the talents for Industry 4.0.

Keywords: industry-school collaboration, SMSCP, Siemens, secondary technological and vocational Schools cooperation with industries

技術型高中產學合作之研究--以西門子機電系統認證課程為例

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摘要

為解決人力供應落差，教育部鼓勵產學合作。據此，南港高工和西門子於 2014 開始合作關係。本文係以西門子的經驗為基礎，採質性研究探討臺灣、德國和韓國的合作模式，並提出建議。根據研究結果，產學合作可以從教師培訓、學生實習和技術認證進行。而人才培養需要動態調整，學校需有改變的彈性。另，給予企業主體性、提供未來工作人力市場的評估，是加強產學合作所必要的。而具有自動化和機電整合相關科別的學校應與企業緊密聯繫，以提供全面的、實用的技職教育，提供工業 4.0 所需的人才。

關鍵字：產學合作、SMSCP、西門子、技術型高中產學合作

1. INTRODUCTION

1.1. Research Background

The School has been recognized as cultivation of manpower for the society. And the goal of the technological and vocational education is especially expected to be supply of industrial manpower. Taiwan Ministry of Education (MOE) has put forward relevant policies to encourage the industry-school cooperation with the expectation that it is the main solution to meet the social expectation for the function of secondary technological and vocational schools.

Under that policy, Siemens Mechatronic Systems Certification Program (SMSCP) has been launched by Nangkang Vocational High School (NKHS). This paper aims to explore how the cooperation works and to analyze the models of cooperation in Taiwan, Germany and Korea based on Siemens's experience, and make recommendations for improvements.

1.2. Literature Review

1.2.1. The Meaning and Importance of Industry-school Cooperation

Human resource development policy is critical to industry development and also determines the national competitiveness. With the rapid changes in the social structures and the trend of global market development, talent cultivation has become the most popular issue in education. Industry-school cooperation refers to the use of different resources from schools and enterprises, and to combine the educational environment which is based on classroom teaching for delivering indirect knowledge with the enterprises which aim to direct acquisition of practical capacities, and also to adjust the link between education and industry with the trends of industries. It is a systematic integration for the main purpose of training applied talents suitable for the industry (Huang Zheng & Song Xiude, 2007；Pingtung Education University Evaluation Studio, 2013).

1.2.2. The Current Policy on Industry-school Cooperation in Taiwan

Taiwan MOE has pointed out that schools should engage in cultivating talents through the close cooperation with industry and should take the interactive approach to provide industry-required personnel, then, the Phase 2 of the Technological and Vocational Education Reform Project (2013-2017) was announced as follows which is optional to schools.

I. Building network: integrating and establishing cooperation mechanism and platform between industry and technical and vocational schools.

II. Offer employment-oriented courses: School co-design the courses with industrial institutions, training institutions in accordance with the needs of industrial institutions.

III. Offer industry-school special classes:

(a) Wheel mode: The two-classes-one- unit with one class in the school, and another class

of teachers in the work site to receive vocational skills training.

(b) Ladder mode: The first and second grade students study in school and in the third grade students have to do their internship in the cooperative institutions.

(c) Internship mode: The school assign students to the cooperative institutions to have vocational skill training during summer or winter vacation without adjust any courses and the curriculum structure.

IV. Invitation of the industry experts to be the co-teachers:

The schools can invite the industry experts to teach in the classes based on the collaboration with a school teacher.

V. To enhance the industry internship and enhance professional experience:

(a) Workplace experience: The schools can arrange the first and second grade students to related institutions for a half-day or one-day participation activities.

(b) Industry internship: The schools can arrange the second grade students to related institutions for internship for one to six weeks (MOE, 2012).

1.2.3. The Current Policy on Industry-school Cooperation in Germany

Germany has always advocated the same value of academic and vocational education, hence, the vocational education develops on a good foundation. The industry-school cooperation in Germany is the dual system, which can be traced back to the guild at the Middle Ages, laying a "learning by doing" and "doing by learning" basis of the mode of cooperation. With the impact of economic globalization, low fertility and the rapid change of industrial structure, the goals of dual system have also been updated with the new Vocational Training Act issued in 2005 to ensure that young people just getting started in the world of work have full vocational capacity in a wide range of activities, so that they can be expected to continue to change their expertise in a career and skills and competences acquired can also be transferred to other fields of employment, something which increases occupational mobility at the same time (Anja, H., 2015 ; Kuppe, A. M., Lorig, B., Stohr, A., & Schwarz, H., 2014).

In response to the adjustment of the curriculum and the training structure, the qualifications of trainers are also adjusted to maintain the quality of vocational training through the quality control mechanism of the qualification of trainers.

According to the Vocational Training Act, Germany clearly defines the right and obligation of the apprentices and the enterprise and the State, that is to say, the Vocational Training Act stipulates that the cultivation of professional workers is the obligation of enterprises. (Zhang Ren home & Yu Zongda, 2014).

The procedure of enrollment and training model is that the enterprise to release the apprentice position, the student can freely apply for vocational education subjects and business options, after the interview accepted, the student can be registered in the industry association as an apprentice and at the same time the student also can be enrolled in the cooperative vocational school. In the dual system, students generally receive training in enterprises for 3-4 days a week. Unlike Taiwan, schools recruited students and find the training companies for students. It seems that students are the obligation of schools.

1.2.4. The Current Policy on Industry-school Cooperation in Korea

Education is highly valued by all parts of Korean society (Kuczera M., Kis V. & Wurzburg G., 2009). The Korean vocational education beginning at high school level, students choose different school tracks based on their aptitudes and plans for future education and/or career pursuits. The three types of high schools in Korea including general high schools, special purpose high schools and specialized high schools.

In Korea, VET institutions often see themselves as having a largely academic orientation but they are expected to provide job-ready recruits for industry. But, in fact, links between the VET system and industry and business are generally weak. It is hard to help the VET system to meet rapidly changing labor market needs (Kis, V., & E. Park, 2012). While some of the origins of mismatch are rooted in culture and tradition, some features of the Korean education and training system also contribute to the challenge (Howard R. D. Gordon, 2014). The government is committed to develop and initiate a number of policies and initiatives designed to overcome the existing mismatches. In keeping with these policy plans, 21 "meister schools" have been established as of 2010. Meister which means the master of a trade. High Schools are converted vocational schools that partner with companies in specific industries to create educational experiences tailored to the needs of the workforce. They emerged in an effort to turnaround vocational schools that were looked down upon within their communities. The schools were founded with the aim of training students to become skilled workers in various industries, including new media contents, energy, machinery, mechatronics, and telecommunications among many others. The government supports these schools and their students by mandating the school dorm system, offering tuition waivers, and providing training for teachers to strengthen their field experience. Korea plans to continue reducing the number of specialized high schools to overhaul the existing specialized high school system so that these schools may serve as a nurturing ground for higher skilled technical workers (Park, D,Y., 2011).

Korea has developed the National Competency Standard (NCS) since 1996 which define the knowledge, skills and qualities required of workers in specific occupational fields in order to set systematic criteria based on which individuals may be educated and trained. So far, to

strengthen secondary vocational education and minimizing skills mismatch, Korea has developed NCS for 276 occupations in in 20 broad industry categories. NCS has been applied in designing customized programs for junior colleges and meister schools. By 2015, the NCS will also apply to specialized high schools (Lee, J., 2017; Mee-Souk KIM, 2013; Park, D. Y., 2011).

1.2.5. Siemens Mechatronic Systems Certification Program (SMSCP)

SMSCP is the marriage of electrical, mechanical and computer engineering these three engineering fields, better known as mechatronics plays an ever-increasing role in modern technology. Because technology becomes more and more complex by yearly. To guarantee a world-class technical skills standard, the Siemens Technik Akademie Berlin (STA) cooperates with qualified schools with the following key aspects of partnership:

I. SMSCP Partner Schools must have a mechatronic training system on site.

II. Schools must have at least two certified teachers for the Level they plan to implement.

III. The lectures must be held in the English language.

IV. There must be an agreement with Siemens in a written form.

Along with specialized technical content, SMSCP focuses on providing a wide range of skills in trouble-shooting and systems-thinking. Also it's ambition is to provide the pedagogical and technical expertise to partner schools around the world and help them add value to existing programs. SMSCP adopts an innovative system approach. The goal is to develop Handlungskompetenz – adaptive, innovative thinking – in the world's workforce. With its system focus and holistic learning model which stresses:

I. The Mechatronic System is always the "starting point".

II. Contextual, Hands-on learning of theoretical principles using a Mechatronic System.

III. Understanding of subsystems interrelationships and how they drive system functions together.

IV. It is comprehensive and focus on troubleshooting & systems analysis.

SMSCP certification includes three levels built on job profiles:

Level 1: Siemens Certified Mechatronic Systems Assistant, which emphasizes on efficiently operating complex mechatronic systems, troubleshooting and foreseeing problems.

Level 2: Siemens Certified Mechatronic Systems Associate, which focuses on systems management, investigation, repair and troubleshooting.

Level 3: Siemens Certified Mechatronic Systems Professional, which emphasizes on professional systems engineering.

Siemens's training solutions are

I. Customizable to other countries and their local requirements (e. g. education systems).

II. Versatile with other companies and their company-specific requirements (e. g. product focus).
III. Complementary to curricula of Global Learning Campus and the Siemens Product Schools, or third-party providers.

Through the global Siemens training programs Siemens can contribute to tackling societal challenges like (youth) employability and acquire new business (Siemens, 2017).

1.2.6. SMSCP in Korea-a Case Study of CMTHS

Founded in 1974 and transferred to a meister high school in 2010, Chonbuk Mechanical Technical High School (CMTHS) applies apprentice system. CMTHS keeps the cooperation with 233 enterprises. The strategies of instruction are the smaller class size, modeling and project learning, strengthening the employability of students, close cooperation and exchanges with the industry, assigning students to the industry to carry out practical learning and aiming in the immediate employment after graduation. Their students are required not to study in university immediately after graduation.

CMTHS follows Siemens SMSCP and SCE Internship Workshop model, but the school uses Siemens, Mitsubishi and Korean PLC system at the lab. Students study in the school at the first year and study in the industries at the next two years. SMSCP is integrated into other courses in CMTHS.

1.2.7. SMSCP in Taiwan-a Case Study of NKHS

NKHS has built the collaboration with Siemens since 2014 without change the national curriculum framework, the strategy adopted as follows:
I. Take the chain building as the main axis, so progressive integration into the existing curriculum is the policy.
II. Take gradual expansion of the participation of various departments in the form of ripples is the model.
III. Take the scheduled expand as the goal, starting from the automotive technical cooperation center gradually become a partner school.
IV. To fully benefit, the collaboration is not just for students learning but also for the teacher professional development.

The cooperation has been taking in the following aspects:

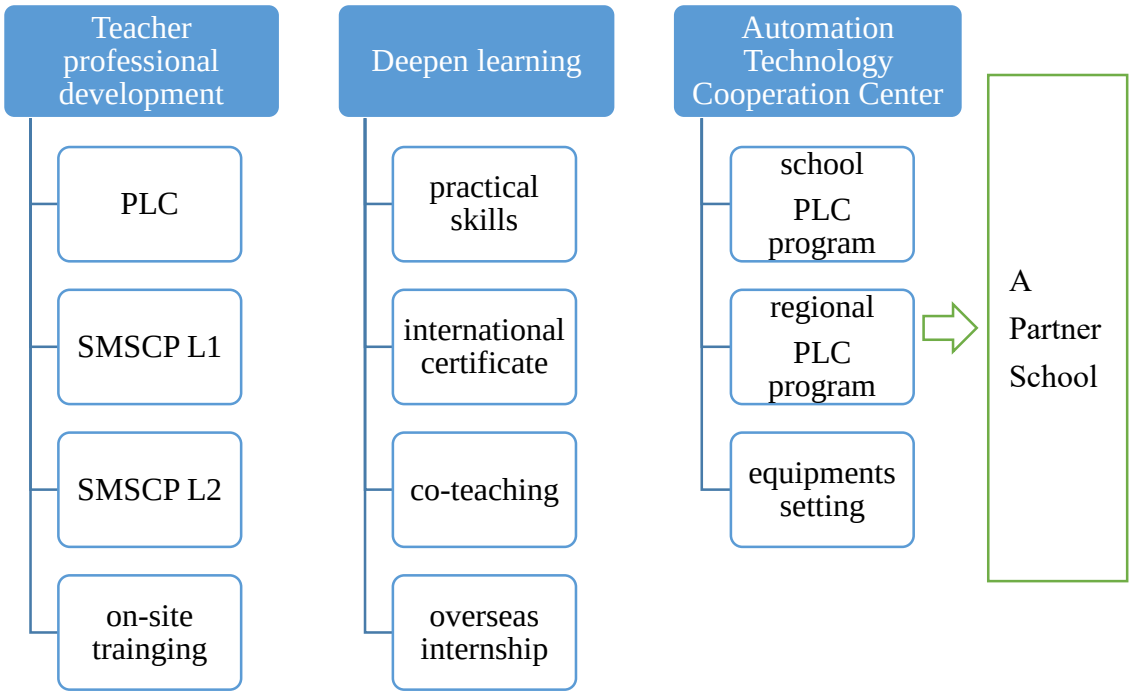

Figure 1. The cooperation aspect conducted by NKHS with Siemens

The project in 2014 has set up the Automation Technology Cooperation Center and the setting of equipment has been in progress. The PLC programs has launched from 2014 for NKHS students and the other students of Taipei city. The overseas skills internship offered by STA has implemented since 2014 every year. In 2016, two teachers had obtained SMSCP L1 trainers 'certification and 2017 a teacher is conducting the on-site training plan. SMSCP is implemented in the form of mini course in NKHS.

1.3. Establishing a Niche

As a school principal and a manager of industry, the authors have on-site experiences and also they are observers and participants who will adopt a reflective approach and viewpoints angle to study it. The aim is to promote a practical model for connecting Taiwan technological and vocational students with the international certificated skills. From on-site move forwards to concept spread and practice expansion should be the niche.

1.4. Research Purpose

The research aims to analyze effective strategies and puts forward relevant suggestions and to provide the reference for the educational administrative organs and other schools to promote the policies related to the collaborations between industries and schools.

Moreover, to give the productive suggestions to schools to promote the on-site dos in order to make the schools meet the goal of cultivating the practical talents for industries.

1.5. Research Questions

Two issues that need to be resolved in this regard are (a) whether we can reach the international solidarity regarding the specific skill field of an industry, and (b) whether we can incorporate such industry into the way we adopt to cultivate our talents in secondary technological and vocational schools.

1.6. Value of Research

As core person in the cooperation, the authors provide the reference for the educational administrative organs and other schools to promote, and the suggestions should be more productive and meet the goal of cultivating the practical talents.

2. METHOD

2.1. Research Design

The paper adopted the qualitative research approach. In order to improve the research faithfulness, the methods adopted including taking participatory observation, interviewing and collecting the data related to the subject. The data collected are analyzed, and the practical practices, dilemmas, solution strategies and the feasibility of sustainable development in the future are discussed.

2.2. Subjects/ Materials

The main subject of this research is the SMSCP which is a program aims in cultivating certificated talents for Siemens and it has been implemented among international countries including European countries, U.S.A., UK, Korea, China and so on.

The interest of this research is focus on the comparison of international practices of SMSCP which are in STA, NKHS, CMTHS.

2.3. Data Collection Procedure

The whole data collection procedures are:

Step 1: Identify issues and/or opportunities for collecting data. Step 2: Select issue(s) and/or opportunity(ies) and set goals. Step 3: Plan an approach and methods. Step 4: Collect data. Step 5: Analyze and interpret data through qualitative data approach. Step 6: Act on result.

Regarding ethics in data collection, management of data collection and designing of data collection instruments all have been kept as privacy issues.

2.4. Data Analysis

The data analyzed from two dimensions:

From the macro dimension, the interest is focus on how the industry talents needed in the economic development from the perspective of the cultivation of technical talents and how to connect with the development direction of technical and vocational education. Regarding the micro dimension, the paper explores how the education policy and expectation are translated into practical practice, and the practical practices, dilemmas, solution strategies and the feasibility of sustainable development in the future are discussed.

3. RESULTS AND DISCUSSION

With the global orientation of the automatic production, the industrial structure and industrial manpower demand have changed greatly all over the world. More and more mismatch exists between school education and job demand leading to unemployment of youth. Comparing with Germany and Korea, the employment rate of the youth (15-24 years old) of Taiwan is lower than Germany and Korea which in 2008 is 26.61% and declined to 26.60% in 2015; while the rate of Germany in 2008 is 47.19% and declined to 45.29% in 2015; the rate of Korea in 2008 is 23.80% and raised to 26.90% in 2015. Comparing with the rate of OECD countries, Taiwan and Korea is far below the average rate of OECD countries which is 43.03% in 2008 and 40.49% in 2015. In recent years, enterprises in order to reduce costs and enhance the flexibility of human resources, the employment of atypical employment is becoming more and more common, so that young people to engage in atypical employment trend gradually increased. Especially in Taiwan, rate of temporary workers from 2008 to 2015 has risen 6.96% while the rate of Germany has declined 3.14% and Korea has declined 2.39% (National Institute of Science and Political Center, 2017)·

The rate of youth unemployment or employment discussed above has been attributed to the results of the vocational and technical education by public in Taiwan. The vocational and technical education is influenced by the rapid transformation of market mechanism globally. It is necessary to link and adjust the direction of education policy and the industry. In Taiwan, school-industry partnership is typically established to satisfy the needs of local firms rather than to provide broader occupation-specific and transferable skills. Unlike Germany, Taiwan lacks of the training regulations to guide the dual system practices and the solidarity among government sectors. Neither not like Korea, Taiwan has no policy to transfer the schools to the meister school type. All the policies on promoting the cooperation are guidelines and the changes remain to the consideration of schools. The philosophy is school- based not nation-based. It is hard to get the whole picture of the development.

In current Korean context, although it has policy to set up some meister schools, the

government dominates VET policy making with relatively little influence from industry. Therefore, it is employer engagement with the VET system that need to be strengthened.

As the above discussion, the connections among schools, industries and governments are weak in Taiwan and Korea. The SMSCP implementations in Taiwan and Korea need a lot of efforts to take in curriculum mapping. And instruction in Taiwan also limited by the brand of equipment which is teachers' mindset. The holistic system approach as well as the flexible adaptation are the important points to promote teachers to engage in SMSCP. According to the case study in Taiwan and Korea, the pedagogy of SMSCP and emphasis on the logic thinking inspire teachers a lot.

4. CONCLUSIONS

4.1. Conclusions

4.1.1. Without the foundational change of the school practices, SMSCP can be implemented as a mini-course with curriculum mapping

Not like dual system in which VET is supplied in a view to be a component of education, VET in Taiwan needs more efforts to make mapping with the existed curriculum. According to the case of NkHS, the collaboration started from teachers ' training. SMSCP is delivered by the way of field internship and technical certification without change the existing curriculum. It is extra from the regular curriculum and delivered in a form of mini course during winter and summer vacation that is called the third curriculum. It is more intensive than the general courses. After mapping, curriculum structure can be more clear and the skills which are included in the certification will be well connected with and tracked back to the existing theories background that students have had.

4.1.2. Students widen their career horizons with the support of the international enterprise

The core value of industry-school cooperation is to assist young people to prepare for core competencies, to accumulate practices and develop expertise. So as to minimize the gap, it is proposed to strengthen youth's understanding of employment information, to alleviate the atypical employment patterns of young people, to avoid the phenomenon of job insecurity and underemployment, and to alleviate the plight of young people's low pay, so as to solve the dilemma of youth employment.

Most of the cooperation cases in Taiwan are domestic and even local or regional. But regarding to SMSCP case, it positively impacts students by tackling challenges like the marriage of electrical, mechanical and computer engineering fields and the complexity of technology. Plus, the overseas internship with SMSCP offered by STA do widen students'

career horizons. In the near future, there will be education cloud to give the whole concept of how the industry runs which will add more value to such cooperation.

4.1.3. Pedagogy and the system approach of training are the essential components to promote the students to adapt to the rapid change of the practical work

SMSCP is a program with strong pedagogy and system approach, it emphasis to cultivate the competency to face the changes of the future and it offers training solutions combining theoretical study, applied learning, and on-the-job experience. Joint with SMSCP, partner schools do not only get the skills content but also the philosophy of delivery. Industrial demand is influenced by globalization and the development of the times, talent cultivation should increase the dynamic adjustment, schools should grasp the social pulse and need to develop their students' flexibilities to adapt the rapid change of the practical work.

4.1.4. Without the foundational change of the school practices, it is hard to reduce the mismatch of talents cultivation and the workforce needs

According to the report of OECD (2016), employment rate of youth of Korea was lower than Taiwan's in 2008 but exceed Taiwan's in 2015. Korean meister high schools should have contributed to the youth employment rate a lot with the totally change of original school practices. Regarding to the policy of meister school of Korea, it is related to foundational changes of the school system, while Taiwan's policies are more like extra which causes effects but not deeply. Without the foundational change of the school practices, it is hard to reduce the mismatch of talents cultivation and the workforce needs.

4.2. Recommendations

4.2.1. Secondary technological and vocational schools have to re-position themselves and make the best use of the flexibility given by policies

The existing curriculum and even the practices of school in instruction and internship have limitations and regulations. Most of the schools are more academic and not focus on the labor market. Most of students will choose to study in universities after graduation, so the work field remain as a legend before that. As the rapid changes in the industrial technology and the Industry 4.0 are the facts, schools have to re-position themselves both in the missions and functions. Curriculum and internship should have alignment with it. And make the best use of the flexibility given by policies to make it.

4.2.2. Providing the estimate of future labor market to help schools adjust their education directions

German government plays an important role in the link between industry and education and in promoting talents cultivation. In Germany, BIBB, in collaboration with IAB, constructs a model for estimating the supply and demand situation in the future manpower market and adjusts the training by such forecasting manpower demand. It helps to reduce the mismatch between supply and demand. The schools in Taiwan need such kind of data also. Without it, vocational programs offered by schools are lack of reality and the development of talents is just like moving in a dark way.

4.2.3. Giving enterprises subjectivities in the VET is needed for strengthening the cooperative relationship

In dual system, the proposal of VET curriculum is based on career analysis. In this respect, Germany explores the learning field and other new curriculum programs, and actively carry out curriculum reform and innovation. So does Korea. It is noteworthy that although Taiwan MOE has started a lot of polices, the practices are still limited to school teachers, equipment or other factors, and planned on an easy manageable level. The enterprise demand for the quality of personnel is seldom responded by a school curriculum.

The school is conservative, and the enterprise is passive. These are the main reasons cause the mismatch in VET and labor market. The pluralistic cooperation mechanism is not the best prescription. Subjectivity of enterprise is the key point. The framework of industrial development and decision-making model of talent development, the establishment of appropriate and clear rules and cooperative models all have to form from the demand side to strengthen the objectives of the cooperation.

4.2.4. Schools should link with the enterprises to give a holistic and hands-on education to supply the talents for Industry 4.0

Taiwan's OEM industry machinery is quite competitive internationally, but now other countries have begun to evolve. Automation has become a basic element; it is intelligent that determines the future market. There are also many new concepts and practices that continue to emerge, like digital twins. Education and enterprises should respond to the change.

Many secondary technological and vocational schools in Taiwan have several departments related to automation and mechatronic fields in one school. Such schools should give students a holistic and systematic understanding of the practical work with a company like Siemens. Siemens is a global powerhouse focusing on the areas of electrification, automation

and digitalization and knowing that data is the backbone of 21st century companies, so it has been engaging in building a data center ecosystem around the globe which will be included in the education programs as an education cloud. Except the complete spectrum of automation education programs, the students can get the whole picture of how the industry runs. It is far beyond the knowledge of school teachers and would be a compensation of the school vocational education. Through the cooperation with a global enterprise will help Taiwanese companies complete their industry 4.0 layout.

References

Anja, H. (2015). *Change of occupation after training – 18 to 24-year old's with dual vocational education and training in working life*. Retrieved from https://www.bibb.de/en/26572.php

Huang Zheng, & Song Xiude (2007). Education-industry collaboration makes win-win. *2007 International Symposium on Education Strategy Alliance and Management*, National Chiayi University.

Kis, V., & E. Park (2012). *OECD Reviews of Vocational Education and Training, A Skills beyond School Review of Korea*. Retrieved from https://www.oecd.org/education/SBS%20Korea.pdf

Kuczera M., Kis V. & Wurzburg G., (2009). OECD Reviews of Vocational Education and Training, A Learning for Jobs Review of Korea. Retrieved from http://www.oecd-ilibrary.org/education/oecd-reviews-of-vocational-education-and-training-a-learning-for-jobs-review-of-korea-2009_9789264113879-en

Howard R. D. Gordon, (2014). *The History and Growth of Career and Technical Education in America* (pp.343-344). Illinois : Waveland press INC.

Kuppe, A. M., Lorig, B., Stohr, A., & Schwarz, H., (2014). *Training regulations and how they come about*. Retrieved from https://www.bibb.de/veroeffentlichungen/de/publication/show/7324

Lee, J., (2017). *Human resource development and education policy in Korea*. Retrieved from https://www.kdevelopedia.org/resource/view/04201708160148421.do

Mee-Souk KIM, (2013). *Vocational Qualification System in Korea.* Retrieved from file:///C:/Users/USER/Downloads/Qualification%20System.pdf

MOE (2012). *Second phase of the technical and vocational education Reengineering program.* Retrieved from https://www.edu.tw/News_Plan_Content.aspx?n=D33B55D537402BAA&sms=954974C68391B710&s=A072ECF40732A908

National Institute of Science and Political Center (2017). *Trends in the International youth*

labor market. Retrieved from Https://pride.stpi.narl.org.tw/topic2/downloadSource/4b1141ad5aa1e3f6015b1d0259ca1f18

National Pingtung Education University Evaluation Studio (2013). A study on the pra*ctice of industry and business cooperation and enterprise Practice-taking Pingtung University of education as an example*. Retrieved from http://www.scheva.nptu.edu.tw/files/14-1039-37107,r13-1.php

Peng Minghui (2015). *Rhine Mode (1)--dual vocational education in Germany*. Retrieved from https://opinion.cw.com.tw/blog/profile/30/article/2706

Park, D.Y., (2011). *Korean Policies on Secondary Vocational Education, Efforts to Overcome Skills Mismatch and Labor Force Shortage*. Retrieved from https://www.bibb.de/veroeffentlichungen/de/publication/.../6663

Siemens, (2017). *Siemens Mechatronic Systems Certification Program – SMSCP.* Retrieved from: https://www.sitrain-learning.siemens.com/DE/en/content/SMSCP-Siemens-Mechatronic-System-Certification-Program.do

Yang Zhenhe, Cai Jinxiong, Lin (2013). Comparative analysis of domestic and foreign talent cultivation policies. National Institute of Education, unpublished.

Zhang Ren Home, & Yu Zongda (2014). The revelation of Germany's dual system technical and vocational education to Taiwan technical and vocational education. *Taiwan International Research Quarterly*, 10 (3), 173-188.